REMARKS

The substitute specification, filed June 14, 2004, has been amended to rename cells "13a" from "internal cells" to --non-boundary cells-- as supported by Figure 4 as originally filed. Figure 4, as originally filed, illustrates that cells 13a include cells located wholly in the interior of the object 1 and cells located wholly in a region outside of the object 1. Thus, it would be recognized by a person of ordinary skill in the art, as conceded by the Examiner during the previous Examiner Interview (See Interview Summary, dated February 3, 2005), that the cells "13a" are non-boundary cells. The present change in nomenclature, while improving clarity of the disclosure, is fully supported by the application as originally filed.

Furthermore, the definition of "non-boundary cell" in paragraph [0038] has been revised to include cells "wholly in a region outside of the boundary" in addition to cells "wholly in the interior of the boundary" as supported in Figure 4 as originally filed.

The drawings have been amended to re-name cells "13a" as "non-boundary" cells as supported by Figure 4 as originally filed. Figure 4 as originally filed illustrates that cells "13b" are on the boundary of the object (1), whereas cells "13a" include both cells in the region outside the object (1) as well as cells located in the region inside of the object (1). A person of ordinary skill in the art would recognize from Figure 4 that the cells "13a," which were originally named "internal cells," are functionally non-boundary cells. Therefore, the change in nomenclature, while improving clarity, does not constitute new matter.

Claims 2, 3, 8, 9 and 18 have been canceled without prejudice. Claims 1, 4, 7, 10, 13-15 and 19 have been amended, and add new claims 20 and 21 have been added. Specifically, independent claim 1 has been amended to incorporate the subject matter of

claims 2 and 3, and to particularly point out and distinctly claim that "modified Octree division" comprises the steps of: (i) "re-dividing by Octree division only boundary cells, wherein each boundary cell is divided into smaller cells, and each smaller cell is then classified as either a non-boundary cell or a boundary cell;" and (ii) "acquiring cut points by replacing each boundary cell, either strictly or approximately, by cut points on twelve ridge lines in three dimensions and on four ridge lines in two dimensions, wherein re-division of only boundary cells is performed until sufficient cut points are acquired to reconstruct boundary shape elements, including boundary surfaces, included in the external data" as supported by claims 2 and 3 and as described on page 9, line 18, to page 11, line 3, of the specification as originally filed. Claim 4 has been amended to depend upon claim 1.

Independent claim 7 has been amended to incorporate the subject matter of claims 8 and 9, and to particularly point out and distinctly claim that "modified Octree division" comprises the steps of: (i) "re-dividing by Octree division only boundary cells, wherein each boundary cell is divided into smaller cells, and each smaller cell is then classified as either a non-boundary cell or a boundary cell;" and (ii) "acquiring cut points by replacing each boundary cell, either strictly or approximately, by cut points on twelve ridge lines in three dimensions and on four ridge lines in two dimensions, wherein re-division of only boundary cells is performed until sufficient cut points are acquired to reconstruct boundary shape elements, including boundary surfaces, included in the external data" as supported by claims 8 and 9 and as described on page 9, line 18, to page 11, line 3, of the specification as originally filed.

Claim 10 has been amended to depend upon claim 8 and to replace the term "internal cell" with --non-boundary cell-- for the reasons discussed above. Claim 13-14 have been amended in accordance with the amendment to claim 7. Claim 19 has been amended to depend upon claim 17.

New independent claim 20 recites subject matter incorporating claims 7, 8, 9, 10, 11 and 12, as is also supported by the original specification on page 6, line 22, to page 17, line 13. New claim 21 depends upon claim 20 and further recites the step of "expressing corner points by cut points possessed by adjacent boundary cells" as supported on page 11, lines 4-12, of the specification as originally filed.

The present amendments to the specification, drawings and claims adds no new matter to the instant application.

The Invention

The present invention pertains broadly to a method of storing substantial data integrating shape and physical properties such as would be used to store substantial data integrating shape and physical properties of an object so that the data can be stored in a small storage capacity. In particular, in a first embodiment in accordance with the present invention, a method of storing substantial data integrating shape and physical properties is provided that includes the steps of: (a) an external data input step (A) for inputting external data consisting of boundary data of an object; (b) an Octree division step (B) for dividing, by modified Octree division, the external data into cubical divided cells with boundary surfaces orthogonal to each other; and (c) a cell data storage step (C) for storing the values of physical

properties for each of the cells.

In accordance with a second embodiment of the present invention, a method of storing substantial data integrating shape and physical properties is provided that includes the following steps: (a) inputting to a computer external data consisting of boundary data of an object; (b) dividing, by modified Octree division, the external data into cubical first cells with boundary surfaces orthogonal to each other; and (c) storing the values of physical properties for each of the first cells.

In accordance with a third embodiment of the present invention, a method of storing substantial data integrating shape and physical properties is provided that includes the steps recited in claim 20.

In all of the embodiments, in accordance with the present invention, external data inputted to a computer is divided into cells using modified octree division, which requires classifying cells as either non-boundary cells located in the interior or the outside region of the object, or as a boundary cells including a boundary surface of the object, wherein the modified Octree division comprises the steps of: (i) re-dividing by Octree division only boundary cells, wherein each boundary cell is divided into smaller cells, and each smaller cell is then classified as either a non-boundary cell or a boundary cell; and (ii) acquiring cut points by replacing each boundary cell, either strictly or approximately, by cut points on twelve ridge lines in three dimensions and on four ridge lines in two dimensions, wherein re-division of only boundary cells is performed until sufficient cut points are acquired to reconstruct boundary shape elements, including boundary surfaces, included in the external data.

Various other embodiments in accordance with the present invention are recited in the dependant claims. An advantage of the various embodiments, in accordance with the present invention, is that a method of storing substantial data integrating shape and physical properties is provided that more efficiently stores substantial data so that smaller storage capacities can be utilized during CAD and simulation operations. Furthermore, the methods in accordance with the present invention actually allow for the integration of CAD and simulation operations because the modified Octree division makes it possible to manage information related to both procedures.

The Rejections

Claims 1-4, 7-10, 13-15, 18 and 19 stand rejected under 35 U.S.C. § 103(a) as unpatentable over the Kela reference (Ajay Kela, *Hierarchical octree approximations for boundary representation-based geometric models*, Computer-Aided Design 355 (1989)) in view of Shu et al. (U.S. Patent 6,075,538). Claims 5, 11 and 16 stand rejected under 35 U.S.C. § 103(a) as unpatentable over the combination of the Kela reference and the Shu Patent, and further in view of the Shute reference (Gary Shute, *Overview of C Programming, at* http://www.d.umn.edu/~gshute/C/overview.html (last modified Aug. 23, 1999)). Claims 6, 12 and 17 stand rejected under 35 U.S.C. § 103(a) as unpatentable over the combination of the Kela reference and the Shu Patent, and further in view of Dundorf (U.S. Patent 5,197,013).

Applicants respectfully traverse the rejection and request reconsideration of the instant application for the following reasons.

Applicants' Arguments

The Examiner has objected to the specification and to claims 13 and 14 on the grounds that "[d]efining internal cells as being located in the region outside of the object is considered repugnant to the usual meaning of the term." As conceded by the Examiner, Figure 4 as originally filed illustrates that "internal cells" include both cells located wholly in the interior of the object and cells located wholly in the region outside of the object (See Office Action, dated November 16, 2004, at 2, lines 12-15, and the Examiner's Interview Summary, dated February 3, 2005). Applicants have amended the instant specification and claims replacing the label "internal cell" with --non-boundary cell--, which is believed to overcome the Examiner's objection to the specification and claims.

103 Rejections

A patentability analysis under 35 U.S.C. § 103 requires (a) determining the scope and content of the prior art, (b) ascertaining the differences between the prior art and the claimed subject matter, (c) resolving the level of ordinary skill in the pertinent art, and (d) considering secondary considerations that may serve as indicia of nonobviousness or obviousness. Graham v. John Deere Co. of Kansas City, 148 U.S.P.Q. 459, 467 (1966). Furthermore, the Federal Circuit has held that to reject claimed subject matter in view of a combination of prior art references, a proper analysis under 35 U.S.C. § 103 must show that (a) the prior art would have suggested to those of ordinary skill in the art that they should make the claimed composition or device, (b) the prior art reveals that in so making, one of ordinary skill would

have a reasonable expectation of success, and (c) both the suggestion and the reasonable expectation of success is found in the prior art and not in applicant's disclosure. In re Vaeck, 20 USPQ2d 1438, 1442 (Fed. Cir. 1991). In the present case, the scope of the prior art is insufficient to support the Examiner's Section 103 rejection.

The Kela Reference

The Kela reference teaches "hierarchical octree approximations for boundary representation-based geometric models" that includes an octant classification procedure, as shown in Figure 1, using three types of octants: (i) "IN" octants, which are located wholly in the interior of the solid object, (ii) "OUT" octants, which are located wholly outside of the solid object, and (iii) "NIO" octants, which are boundary octants being neither wholly inside or wholly outside of the solid object (Kela reference, at 355, col. 2, lines 2-20).

For this reason alone, the Kela reference cannot teach, or even suggest, the step wherein "each divided cell is classified as either a non-boundary cell located in the interior or in the outside region of the object, or as a boundary cell including a boundary surface" as recited in independent claims 1, 7 and 20 of the present application. In accordance with the present invention, cells are classified as either non-boundary cells or boundary cells. There are no other kinds of cells besides these two kinds. On the other hand, the Kela reference teaches classifying cells into three types of cells: IN octants (i.e., cells located inside the object), OUT octants (i.e., cells located outside the object), and NIO octants (i.e., boundary cells) as admitted by the Examiner (Office Action, dated November 16, 2004, at 4, lines 16-21).

A person of ordinary skill in the art would recognize that the method of the present invention utilizes a 2-dimensional matrix (non-boundary, boundary) for dividing and classifying the external data, while the method taught by the Kela reference utilizes a 3-dimensional matrix (IN, OUT, NIO) for this purpose. Clearly, a 2-dimensional matrix is simpler and more easily and quickly calculable than a 3-dimensional matrix.

As admitted by the Examiner, the Kela reference does not teach the step of "storing the values of physical properties" as recited in claims 1, 7 and 20 (Office Action, dated February 17, 2004, at 4, lines 9-10; and Office Action, dated November 16, 2004, at 3, lines 20-21).

In addition, the Examiner admits that the Kela reference does not teach "acquiring cut points" as recited in claims 1, 7 and 20 (Office Action, dated February 17, 2004, at 6, lines 5-11; and Office Action, dated November 16, 2004, at 5, lines 1-4). Instead, the Examiner points out, and rightly so, that it is the Applicants who teach "acquiring cut points by replacing each boundary cell, either strictly or approximately, by cut points…" as recited in claims 1, 7 and 20, in accordance with the present invention. In making the Section 103 rejection, it is clear that the Examiner relies on the Applicant's disclosure when he concludes that "boundary cells and cut points are considered functionally equivalent" and therefore obvious (Office Action, dated November 16, 2004, at 5, lines 1-4, and at 10, lines 6-8).

Plainly, the Examiner's Section 103 rejection is impermissibly grounded in Applicants' disclosure, and not in the prior art. See In re Vaeck, 20 USPQ2d at 1442. Specifically, the Examiner is using Applicants' disclosure, which describes substituting cut points, either strictly or approximately, for boundary cells, as his basis for concluding that cut

points and cells are equivalent and obvious (Office Action, dated November 16, 2004, at 5, lines 1-4). The Examiner must show where in the prior art, and not in Applicants' disclosure, there is a motivation to substitute cut points for boundary cells.

These are not the only deficiencies in the teachings of the Kela reference. The Kela reference teaches a conventional Octree division method, whereas the present invention as recited in claims 1, 7 and 20 performs "dividing, by modified Octree division." The Examiner's attention is directed to Figures 7A and 7B of the present application, which illustrate the difference between conventional Octree division (see Figure 7A) and modified Octree division (see Figure 7B). Applicants' "modified Octree division" is fully described on page 9, line 25, to page 10, line 14, of the specification as originally filed. Claims 1, 7 and 20, in accordance with the present invention, recite that "modified Octree division comprises the steps of: i. re-dividing by Octree division only boundary cells, wherein each boundary cell is divided into smaller cells, and each smaller cell is then classified as either a non-boundary cell or a boundary cell; and ii. acquiring cut points..., wherein re-division of only boundary cells is performed until sufficient cut points are acquired to reconstruct boundary shape elements, including boundary surfaces...."

Persons of ordinary skill in the art would immediately recognize from Figures 7A and 7B that "modified Octree division" in accordance with claims 1, 7 and 20 of the present invention is superior over conventional Octree division shown in Figure 7A because less data points are required to map the surface of the same object.

Lastly, the Kela reference fails to teach, or even suggest, (a) that each "non-boundary cell has one kind of physical property value as an attribute, and each boundary

cell has two kinds of physical property values relating respectively to the interior of the object and to regions outside of the object" as recited in claims 4, 10, 15 and 20 (Office Action, dated February 17, 2004, at 6, lines 17-19); (b) that the "physical values consist of constant values which do not change by simulation, and variables which change as a result of simulation" as recited in claims 5, 11, 16 and 20 (Office Action, dated February 17, 2004, at 8, lines 6-8; and Office Action, dated November 16, 2004, at 7, lines 1-3, and at 10, lines 9-11), and (c) that the "external data" is "curved surface data for a three dimensional CAD or CG tool" as recited in claims 6, 12, 17 and 20 (Office Action, dated February 17, 2004, page 9, lines 7-8; and Office Action, dated November 16, 2004, at 7, lines 21-22).

In view of all of the apparent deficiencies of the Kela reference outlined above, the Kela reference can neither anticipate, nor render obvious, the subject matter of claims 1, 4-7, 10-17 and 19-21 of the present application.

The Shu Patent

The Shu Patent teaches a "time and space efficient data structure and method and apparatus for using the same for surface rendering," which utilizes conventional octrees, preferably summarized information octrees (SIOs), (col. 5, lines 46-65). It is noted that the Shu Patent actually teaches 2-dimensional quadtrees, and merely suggests application to 3-dimensional SIO (col. 5, line 66, to col. 6, line 8). The Shu Patent teaches that in 3-dimensions, the volume data set for a 3-dimensional space scalar field would be partitioned into NxNxN identical cubes, with each cube having 6 faces and 8 voxels (col. 6, lines 18-34).

Each "cube" is also referred to as a "cell," and each cell is classified according to its density value as either a 0-cell, a 1-cell, or an S-cell (col. 1, line 25, to col. 2, line 27). Specifically, Shu defines cells as follows: an 0-cell has, for each of the 8 voxels, a density value less than a threshold value t; a 1-cell has, for each of the 8 voxels, a density value more than the threshold value t; and an S-cell has some voxels with a density value less than t and some voxels with a density value greater than t (col. 2, lines 14-27).

There is nothing in the Shu Patent that teaches, or even suggests, (a) "dividing, by modified Octree division, the external data into cubical ... cells with boundary surfaces orthogonal to each other, wherein each ... cell is classified as <u>either</u> a **non-boundary cell** located in the interior or the outside region of the object, or as a **boundary cell** including a boundary surface of the object; (b) that "modified Octree division comprises the steps of: i. re-dividing by Octree division only boundary cells, wherein each boundary cell is divided into smaller cells, and each smaller cell is then classified as either a non-boundary cell or a boundary cell; and ii. acquiring cut points..., wherein re-division of only boundary cells is performed until sufficient cut points are acquired to reconstruct boundary shape elements, including boundary surfaces, included in the external data;" and (c) "acquiring cut points by replacing each boundary cell, either strictly or approximately, by cut points on twelve ridge lines in three dimensions and on four ridge lines in two dimensions" as recited in claims 1, 7 and 20, in accordance with the present invention.

As discussed above, the Shu Patent teaches a three-way classification scheme (i.e., 0-cell, 1-cell, S-cell) for each cell of the volume data set, which is similar to the three-way classification scheme (i.e., IN, OUT, NIO) taught by the Kela reference. Therefore, the Shu

Patent fails to teach the two-way classification of "cells" as either "non-boundary" or "boundary" as recited in claims 1, 7 and 20 of the present invention for the same reasons that the Kela reference fails to teach this limitation. As conceded by the Examiner, the Shu Patent also does not teach, or even suggest, (d) that each "non-boundary cell has one kind of physical property value as an attribute, and each boundary cell has two kinds of physical property values relating respectively to the interior of the object and to regions outside of the object" as recited in claims 4, 10, 15 and 20 (Office Action, dated February 17, 2004, at 4, lines 18-21); (e) that the "physical values consist of constant values which do not change by simulation, and variables which change as a result of simulation" as recited in claims 5, 11, 16 and 20 (Office Action, dated February 17, 2004, at 8, lines 6-8; and Office Action, dated November 16, 2004, at 7, lines 1-3, and at 10, lines 9-11), and (f) that the "external data" is "curved surface data for a three dimensional CAD or CG tool" as recited in claims 6, 12, 17 and 20 (Office Action, dated February 17, 2004, page 9, lines 7-8; and Office Action, dated November 16, 2004, at 7, lines 21-22).

The Shute Reference

The Shute reference provides an "Overview of C Programming," and defines a "variable" and a "constant." Specifically, the Shute reference teaches that a "variable is a named or unnamed place for storing mutable data...declared globally...or local to a function" (Shute reference, at 1, lines 25-27). On the other hand, the Shute reference teaches that "a constant is a named or unnamed non-mutable program value...defined by preceding an initialized variable definition with a keyword constant" (Shute reference, at 5, lines 5-7).

All the Shute reference teaches is that variables and constants are elements of C Programming. The scope of the teachings of the Shute reference is extremely limited.

The Shute reference does not teach, or even suggest, that the "physical values consist of constant values which do not change by simulation, and variables which change as a result of simulation" as recited in claims 5, 11, 16 and 20 of the present application. In other words, the Shute reference does not teach, or even suggest, that "physical values consist of constant values...and variables" as recited in the instant claims.

The Dundorf Patent

The Dundorf Patent teaches a "method of forming a carved sign using an axially rotating carving tool," which relates to producing a carved sign using a CAD/CAM computer (col. 7, lines 1-10). The Dundorf Patent teaches an application of the parametric cubic curve to geometrical and graphical modeling (col. 9, line 19, to col. 12, line 55), and suggests that conventional Octree encoding can be used as a data structure for representing a three-dimensional object (col. 17, lines 18-40). However, the Dundorf Patent does not teach, or even suggest, (a) "modified Octree division," (b) the two-way classification of "cells" as either "non-boundary" or "boundary," and (c) the step of "acquiring cut points" as recited in claims 1, 7 and 20 in accordance with the present invention.

Summary of the Prior Art

It is apparent that neither the Kela reference, the Shu Patent, the Shute reference nor the Dundorf Patent teach, or even suggest, (a) "dividing, by modified Octree division, the

external data into cubical ... cells with boundary surfaces orthogonal to each other, wherein each... cell is classified as either a **non-boundary cell** located in the interior or the outside region of the object, or as a **boundary cell** including a boundary surface of the object; (b) that "modified Octree division comprises the steps of: i. re-dividing by Octree division only boundary cells, wherein each boundary cell is divided into smaller cells, and each smaller cell is then classified as either a non-boundary cell or a boundary cell; and ii. acquiring cut points..., wherein re-division of only boundary cells is performed until sufficient cut points are acquired to reconstruct boundary shape elements, including boundary surfaces, included in the external data;" and (c) "acquiring cut points by replacing each boundary cell, either strictly or approximately, by cut points on twelve ridge lines in three dimensions and on four ridge lines in two dimensions" as recited in claims 1, 7 and 20, in accordance with the present invention.

As discussed above, both the Kela reference and the Shu Patent teach dividing object data into cells classified in three dimensions. The mapping paradigms taught by the Kela reference and the Shu Patent would be inoperative if cell division were limited to only two classifications.

The Federal Circuit has ruled that a proposed modification of the prior art that obliterates a feature taught by the prior art, thereby rendering operation impaired, is not permitted to create a prima facie case of obviousness. McGinley v. Franklin Sports Inc., 60 U.S.P.Q.2d 1001, 1010 (Fed. Cir. 2001). In the present case, there is simply no suggestion grounded in the prior art to contract the 3-dimensional cellular matrices taught by the Kela reference and the Shu Patent into a 2-dimensional cellular matrix (i.e., boundary and non-

boundary cells), which is a recited feature in claims 1, 7 and 20 of the present invention. Furthermore, a person of ordinary skill in the art would not have a reasonable expectation that the methods taught by the Kela reference and the Shu Patent would be operative if such a conversion were carried out.

In addition, the individual references cannot be employed under 35 U.S.C. § 103 as an impermissible mosaic to recreate a facsimile of the claimed invention. Northern Telecom, Inc. v. Datapoint Corp., 15 U.S.P.Q.2d 1321, 1323 (Fed. Cir. 1990). In the present case, the Shute reference only teaches that variables and constants are used in C Programming. The scope of the teachings of the Shute reference does not include programming "physical property values" to "consist of constant values...and variables" as recited in claims 4, 10, 15 and 20. Any application of the Shute reference to the teachings of the Kela reference and the Shu Patent lacks a proper suggestion grounded in the prior art to justify employing both constant values and variables to "physical property values;" therefore, the proposed combination is an improper facsimile created by the Examiner from a prohibited mosaic of the prior art.

The Dundorf Patent cannot make up the multiple deficiencies in the teachings of the Kela reference, the Shu Patent and the Shute reference. In particular, the teachings of the Dundorf Patent are limited to showing that parametric cubic curves can be applied to geometrical and graphical modeling, which includes methods employing conventional Octree division. The Dundorf Patent does not teach, or even suggest, (a) "dividing, by modified Octree division...," (b) classifying "each....cell...as either a non-boundary cell...or a boundary cell..., and (c) "acquiring cut points..." in accordance with claims 1, 7 and 20 of

the present invention.

Claim 20

In order to establish a prima facie case of obviousness over claim 20 of the present application, the Examiner must show a proper suggestion, grounded in the prior art and not Applicants' disclosure, to justify combining the Kela reference, the Shu Patent, the Shute reference and the Dundorf Patent. However, the Examiner has not established a proper suggestion grounded in the prior art to support such a combination. Furthermore, the scope and content of the prior art would still fail to teach, or even suggest, (a) "dividing, by modified Octree division, the external data into cubical ... cells with boundary surfaces orthogonal to each other, wherein each... cell is classified as either a **non-boundary cell** located in the interior or the outside region of the object, or as a **boundary cell** including a boundary surface of the object; (b) that "modified Octree division comprises the steps of: i. re-dividing by Octree division only boundary cells, wherein each boundary cell is divided into smaller cells, and each smaller cell is then classified as either a non-boundary cell or a boundary cell; and ii. acquiring cut points..., wherein re-division of only boundary cells is performed until sufficient cut points are acquired to reconstruct boundary shape elements, including boundary surfaces, included in the external data;" and (c) "acquiring cut points by replacing each boundary cell, either strictly or approximately, by cut points on twelve ridge lines in three dimensions and on four ridge lines in two dimensions" as recited in claims 1, 7 and 20, in accordance with the present invention.

Claims 19 and 21

Claims 19 and 21 recite the additional step of "expressing corner points by cut points possessed by adjacent boundary cells." The Examiner contends the "vertices" of a given boundary octant, which are shared by another given boundary octant, are considered "cut points" and cites Figure 3 of the Kela reference in support of this position (Office Action, dated November 16, 2004, at 6, lines 15-17). However, "corner points" are defined by Figure 4 of the present application, as originally filed, to include "points" (16) that are not shared by "another given boundary octant." A person of ordinary skill in the art would immediately recognize that the Examiner's position is not consistent with the definition of "corner point" provided by the present application or by any teaching in the Kela reference.

Conclusion

The rejection under 35 U.S.C. § 103 standing against the claims is untenable and should be withdrawn because neither the Kela reference, the Shu Patent, the Shute reference nor the Dundorf Patent teach, or even suggest, (a) "dividing, by modified Octree division, the external data into cubical ... cells with boundary surfaces orthogonal to each other, wherein each ... cell is classified as either a non-boundary cell located in the interior or the outside region of the object, or as a boundary cell including a boundary surface of the object; (b) that "modified Octree division comprises the steps of: i. re-dividing by Octree division only boundary cells, wherein each boundary cell is divided into smaller cells, and each smaller cell is then classified as either a non-boundary cell or a boundary cell; and ii. acquiring cut points..., wherein re-division of only boundary cells is

performed until sufficient cut points are acquired to reconstruct boundary shape elements, including boundary surfaces, included in the external data;" and (c) "acquiring cut points by replacing each boundary cell, either strictly or approximately, by cut points on twelve ridge lines in three dimensions and on four ridge lines in two dimensions" as recited in claims 1, 7 and 20, in accordance with the present invention. All of the remaining claims depend, either directly or indirectly, upon claims 1, 7 and 20 and are likewise allowable.

For all of the above reasons, claims 1, 4-7, 10-17 and19-21 are in condition for allowance and a prompt notice of allowance is earnestly solicited. Questions are welcomed by the below-signed attorney for applicants.

Respectfully submitted,

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IN THE DRAWINGS:

The drawings have been amended as shown in the marked-up copy attached herewith. As illustrated in the marked-up copy of the drawings, Figure 4 has been further amended. Figure 4 has been further amended to re-name cells "13a" as "non-boundary" cells. As shown in Figure 4 as originally filed, cells "13b" are on the boundary of the object (1), whereas cells "13a" include both cells in the region outside the object (1) as well as cells located in the region inside of the object (1). A person of ordinary skill in the art would recognize from Figure 4 that the cells "13a," which were originally named "internal cells," are functionally non-boundary cells. The change in nomenclature, while improving clarity, does not constitute new matter.

The presently described drawing amendments are incorporated in the formal copy of Figure 4, attached herewith, which incorporates the changes shown in the marked-up copies in compliance with 37 C.F.R. § 1.121(d).

The amended drawings add no new matter to the present application.

ANNOTATED MARKED-UP DRAWING

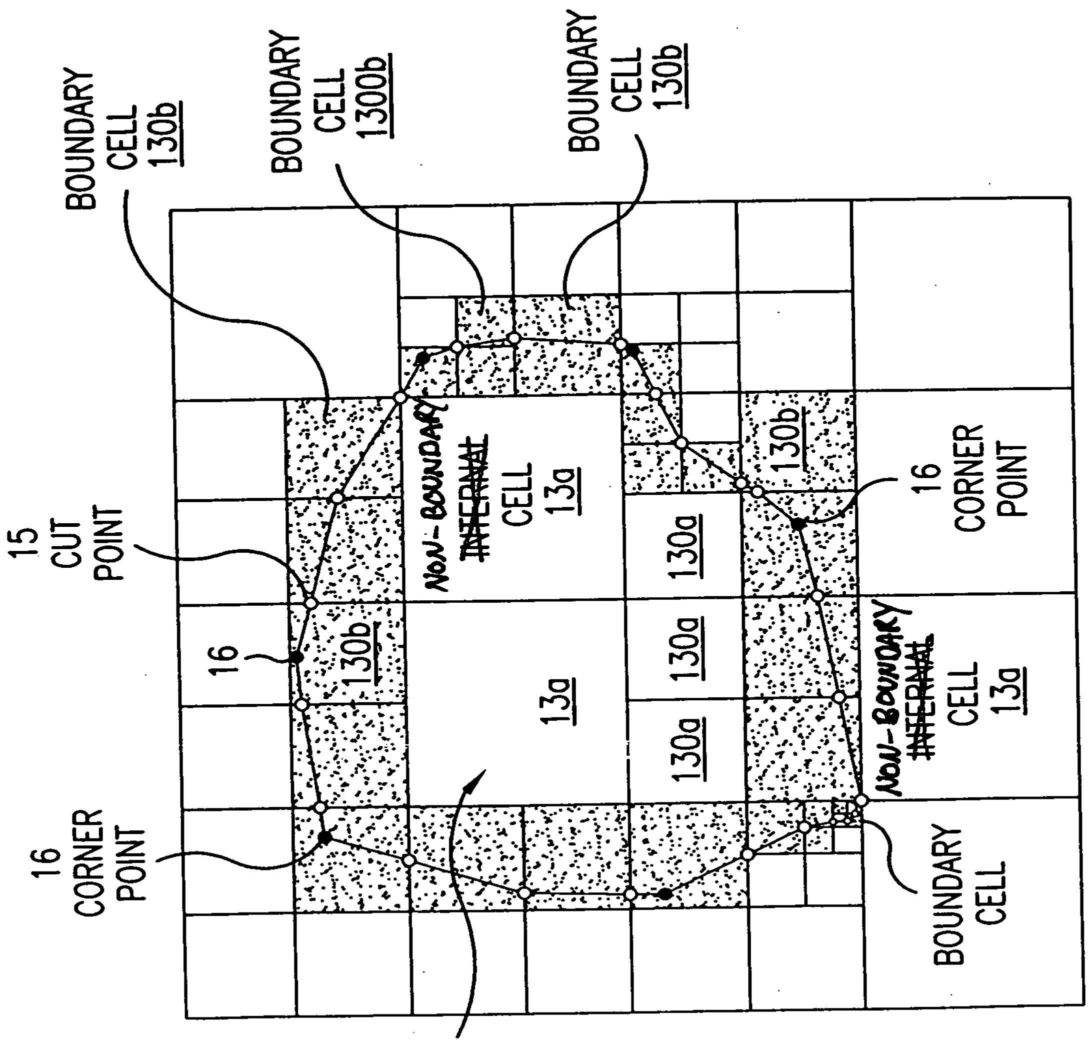

FIG.4